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ENVIRONMENTAL PROTECTION

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NOTE: *The mention of certain products does not necessarily imply their endorsements, nor does the exclusion of other products necessarily imply their disapproval by Alberta Environment.*

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Most of the field survey data reported here were collected, under the direction of the Regional Forest Health Officers, by forest protection technicians and summer crews in the forest areas.

Janet Feddes-Calpas of Alberta Agriculture, Food and Rural Development, provided a Dutch elm disease update for this report. Hiro Koga, a program officer with the Canadian Food Inspection Agency, provided the 2000 gypsy moth survey data in Alberta. Christopher Saunders, an entomologist with the Community Services of the City of Edmonton, provided information on urban forest pests including the satin moth, birch leafminers and pine false webworm.

The following forest industries helped Alberta Environment with the spruce budworm moth surveys carried out in 2000: Brewster Lumber Ltd., Buchanan Lumber Ltd., Canadian Forest Products Ltd. (Hines Creek), and Manning Diversified Forest Products.

SUMMARY

This annual report provides details about forest insect pests, diseases, and noxious and restricted weeds that occurred in Alberta in 2000. Reported here are the results of the aerial and ground surveys of pests; noxious and restricted weed management programs; training and increased awareness on forest health issues; and research and development carried out under the Forest Health Program of Alberta Environment in 2000.

As predicted in 1999, the spruce budworm, *Choristoneura fumiferana* (Clem.) defoliated area in Alberta decreased in 2000, compared to the area defoliated in 1999. An estimated 116 481 ha had moderate or severe spruce budworm defoliation, a 40% drop from the previous year. The results of predictive surveys carried out in 2000 forecast an increased risk of a two-year cycle budworm outbreak in west-central Alberta in 2002. The risk of spruce budworm outbreaks in 2001 remains low in southern Alberta, except in Peter Lougheed Provincial Park with a moderate risk of an outbreak. Areas affected by the current spruce budworm outbreak in northwestern Alberta have a high risk of new outbreaks. In these areas, severity of budworm defoliation will also increase in 2001, except in the 1999 spray blocks. In northeastern Alberta, the risk of new budworm outbreaks in 2001 varies from high to low along a north-south gradient; overall, the risk is moderate in this area. Severity of spruce budworm defoliation in 2001 will be light to moderate in most of the currently infested area of northeastern Alberta, including the 1999 spray block.

The mountain pine beetle, *Dendroctonus ponderosae* Hopkins, populations continued to increase in Banff National Park during 2000. Altogether, there are four infestations in the park, including infestations found this year on Mount Norquay and Stony Squaw Mountain. About 700 green-attack trees were found in these four infested areas. In Jasper National Park, mountain pine beetle survival was low at nine infested sites detected in 1999, but a new infestation was detected in 2000. A ground survey confirmed the presence of 25 mountain pine beetle-killed trees in Willmore Wilderness Park in west-central Alberta. No mountain pine beetle-killed trees were detected during aerial surveys over the "Green Area" and in Waterton National Park in southern Alberta. The mountain pine beetle attacked pheromone-baited trees at many monitoring sites in west-central and southern Alberta, and in Cypress Hills Provincial Park in southeastern Alberta. The number of beetle hits per tree ranged from 1 to 118.

The large aspen tortrix, *C. conflictana* (Walker), defoliated area in the province increased dramatically to reach about 2.3 million ha in 2000. On the contrary, the Bruce spanworm, *Operophtera bruceata* (Hulst.), populations collapsed with the defoliated area declining to 6325 ha in 2000. The forest tent caterpillar, *Malacosoma disstria* Hübner, defoliated area also decreased to about 366 000 ha compared to nearly 600 000 ha defoliated in 1999. This year there were no reports of the black army cutworm, *Actebia fennica* Tauscher, defoliation in the province. Two gypsy moths, *Lymantria dispar* (L.), were trapped during the annual province-wide gypsy moth survey carried out by the Canadian Food Inspection Agency. In the City of Edmonton, the rate of satin moth, *Leucoma salicis* (L.), spread slowed down, and the birch leafminer and pine false webworm, *Acantholyda erythrocephala* (L.), populations declined. However, the yellowheaded spruce sawfly, *Pikonema alaskensis* (Rohwer), populations in Edmonton continued unabated.

Alberta still remains free of Dutch elm disease with no reports of disease occurrence in 2000. There were many incidences of a similar vascular wilt disease, *Dothiorella ulmi*, affecting elm trees in the City of Edmonton. The smaller European elm bark beetle, one of the vector species of this disease, continued to be trapped at many locations in the "White Area" of the province.

A spectacular needle cast infection affected nearly 22 000 ha of pine stands in the Kananaskis Country in southern Alberta.

The provincial noxious and restricted weed management program focussed on education, increased awareness, weed inventories and control. The Forest Health Branch (FHB) published a poster entitled "Problem Weeds of Alberta's Green Area." In 2000, emphasis was to effectively manage noxious and restricted weed infestations in the regions through co-operative programs between the LFS and other stakeholders.

The FHB provided increased awareness and training through posters, pamphlets and workshops. In addition to the poster on weeds, a pamphlet on mountain pine beetle was published during 2000. This year, work commenced on an activity book aimed at introducing the basic forest ecosystem concepts and forest values to children in grades 3 to 6. The FHB of Alberta Environment also helped the Canadian Forest Service, Pacific Forestry Centre, to organize two mountain pine beetle management workshops in Alberta. The Regional Forest Health Officers conducted many workshops and training sessions to increase forest health awareness.

The FHB was instrumental in having a model developed to assess the risk of mountain pine beetle attack in forest stands. In 2000, partial funding was provided for a research project to find ways of commercially producing the satin moth pheromone. Work on a CD-ROM on diagnosing forest pest damage progressed in 2000. Under a contract from the Forest Health Program and a forest industry partner, CFS-Atlantic Forestry Centre staff modified their spruce budworm decision support system to suit Alberta's conditions.

In 2000, use of a multi-spectral camera for aerial overview surveys was investigated. Among the other field trials was a new field trial on the use of pheromone to monitor forest tent caterpillar populations. The 1999 field trial on controlling the Armillaria root disease by stump removal continued this year. Although the Bruce spanworm oviposition traps were deployed again, the number of eggs was low due to the collapse of moth populations.

INTRODUCTION

This report contains details about forest insect and disease conditions in Alberta in 2000 and the forecast on major forest pest conditions for 2001 in Alberta. Reported as well, are the details of noxious and restricted weeds that occur in the forested area (Green Area) of the province. In addition, other forest health-related programs aimed at increasing awareness, training, technology transfer, and research and development are also described.

The vision of the Forest Health Program of Alberta Environment is to develop and maintain an integrated forest health program to protect and maintain a healthy sustainable forest landscape. This program is responsible for addressing forest health concerns within the Green Area of the province. This Green Area is administered by 17 forest areas (Note: before 1999, the forest areas were known as forest districts). These forest areas are organized into four forest regions: Northwest Boreal (NWB) Region, Northeast Boreal (NEB) Region, Northern East Slopes (NES) Region and Parkland, Bow, Prairie (PBP) Region (Figure 1).

The forest pest conditions in 2000 in Alberta were mixed. The decline of black army cutworm and Bruce spanworm populations followed their historical trends. Unusually cold late spring conditions experienced in northwestern Alberta would have contributed to the decline in spruce budworm infestations in that area. However, these weather conditions did not seem to deter explosive growth of large aspen tortrix infestations in the same area.

Figure 1. Forest regions and forest areas in Alberta, 2000.

PEST CONDITIONS IN 2000 AND PREDICTIONS FOR 2001

CONIFER PESTS

SPRUCE BUDWORM, *CHORISTONEURA FUMIFERANA* (CLEMENS)

Aerial Surveys on Defoliation

Aerial surveys were carried out to map and estimate the extent of spruce budworm-defoliated forest stands in the province. The procedure used for these surveys is described in the "Forest Health Aerial Survey Guide" (Ranasinghe and Kominek, 1999). The severity of defoliation was rated as moderate (35% to 70% defoliation) or severe (over 70% defoliation) because light budworm defoliation (i.e., less than 35% defoliation) usually is not visible from the air. The results of the aerial surveys are summarized in Table 1.

Table 1. Spruce budworm-defoliated area in Alberta in 2000, in relation to the budworm defoliated area in 1999

Region	Forest Area	Defoliated Area (ha)				Remarks
		1999		2000		
		Mod.	Sev.	Mod.	Sev.	
Northwest Boreal	Upper Hay	7395	99 468	25 124	47 860	Net area
	MacKenzie	0	18 043	337	9790	Net area
Northeast Boreal	South of lat. 58° [a]	11 261	38 502	14 029	167	Net area
	North of lat. 58° [b]	7119	9869	3464	15 710	Gross area
Sub-total		25 775	165 882	42 954	73 527	
TOTAL		191 657		116 481		

[a] Includes defoliation in the Athabasca Forest Area and in the southern part of the Waterways Forest Area

[b] Includes defoliation in the northern part of the Waterways Forest Area and a part of Wood Buffalo National Park

Northwest Boreal (NWB) *Region*

The aerial survey in this region was carried out between July 19 and August 4. A fixed-wing aircraft (Cessna 206) and a rotary-wing aircraft (Bell 206) were used in these surveys. The budworm-defoliated areas are shown in Figure 2.

As forecasted in 1999, the extent of budworm defoliation within the NWB Region decreased in 2000. Altogether, the spruce budworm defoliated 83 111 ha of host stands in this region. This is a 33% decrease in the defoliated area compared to the area defoliated in 1999. The severity of spruce budworm defoliation decreased with severe defoliation over 69% of the affected area in 2000 compared to severe defoliation over 94% of the affected area in 1999.

In the Upper Hay Forest Area, the spruce budworm defoliated an estimated 72 984 ha in 2000 compared to 106 863 ha defoliated in 1999. This 32% drop in the defoliated area is attributed to

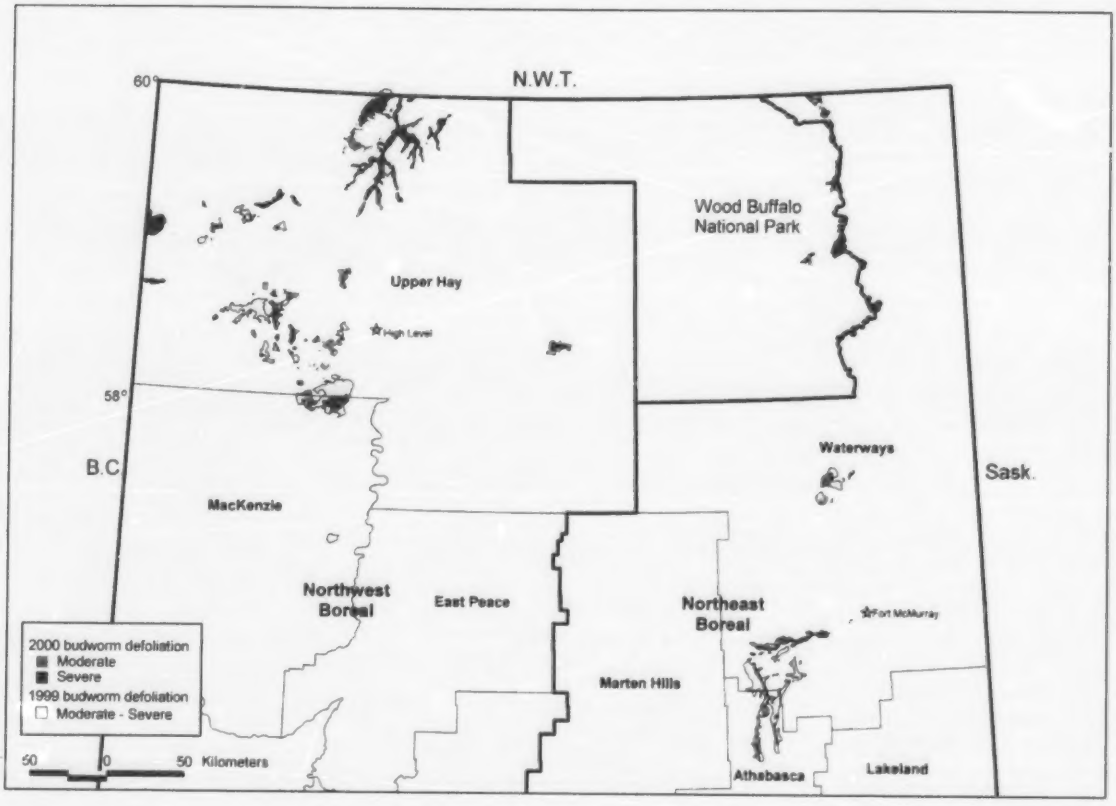

Figure 2. Spruce budworm-defoliated areas in Alberta in 2000, in relation to the budworm-defoliated areas in 1999.

a spray program carried out in 1999 where 60 549 ha were sprayed. Most of these sprayed stands did not have visible defoliation in 2000. An exception was an estimated 23 ha that were sprayed in 1999 but were moderately defoliated in 2000. These were located along the West Sousa Creek, one of the 'hot spots' that appears to develop recurrent spruce budworm infestations in spite of being sprayed.

In the Upper Hay Forest Area, new areas with spruce b[illegible]orm defoliation were found north of Zama City, east of the Shekelie River, and along the Hay River northeast of Meander River. In 2000, spruce budworm defoliation re-appeared after a lapse of a few years in previously sprayed areas near Amber Tower, along the Jackpot Creek, along the Hay River near the B.C. border and along the Steen River.

In the MacKenzie Forest Area, the spruce budworm defoliated an estimated 10 127 ha in 2000 compared to 18 043 ha defoliated in 1999. Out of the affected area, 337 ha had moderate defoliation and 9790 ha had severe defoliation. The budworm defoliation was confined to the Paddle Prairie Metis Settlement. For the first time since the spruce budworm outbreak began in 1994, Hawk Hills and Dunvegan Historical Park areas were free of defoliation in 2000. There was a 44% reduction in the defoliated area although the affected forest stands in this forest area were not sprayed in 1999. This reduction in the defoliated area is attributed, at least in part, to the cool and wet conditions experienced from May through early June in Hawk Hills and near Dunvegan Historical Park areas. There was some decrease in spruce budworm defoliation in the Paddle Prairie Metis Settlement. This may be due to limited food resources available to the budworms following several consecutive years of severe budworm defoliation in this Metis settlement.

Northeast Boreal (NEB) *Region*

An aerial overview survey was conducted from July 11 to 12, 2000, along the major river drainages to estimate the extent and severity of budworm defoliation in this region. The spruce budworm-defoliated areas in this region are shown in Figure 2. In this region, spruce budworm defoliation declined in 2000, compared to 1999.

The spruce budworm defoliated an estimated 14 196 ha south of latitude 58° N. This is a 71.5% decrease in the defoliated area compared to the 49 763 ha defoliated in 1999. Most (64 %) of the budworm defoliation in areas south of latitude 58° N (where phase III forest inventory data are available) was in deciduous-dominant forest stands. Severe budworm defoliation was confined to 167 ha (1.2% of the defoliated area) and moderate defoliation was observed on 14 029 ha (98.8% of the defoliated area) as shown in Table 1. The severely defoliated area was observed southwest of Fort McMurray near Crooked Rapids along the Athabasca River. Moderate budworm defoliation was observed from the Cascade Rapids to Buffalo Creek (2767 ha); near Pelican Rapids (226 ha); along the House River in Townships 79 to 81 in Range 17 west of the Fourth Meridian (489 ha); and on three areas (1460 ha, 8931 ha and 156 ha) from Calumet Lake to Cranberry Lake around Clausen's Landing. There was no visible budworm defoliation in 2000 in areas sprayed with Thuricide® in 1999 along the House River.

In this region, the spruce budworm defoliated an estimated 3237 ha north of latitude 58° N. The estimates for budworm-defoliated areas north of latitude 58° N are gross figures because there

are no forest inventory data available for these areas. This defoliation included 1600 ha of severe defoliation located around the Fitzgerald Settlement southeast of Ft. Smith and 1637 ha of moderate defoliation observed between the Fitzgerald Settlement and Ft. Smith. In addition, an estimated 14 110 ha of severe budworm defoliation and 1827 ha of moderate defoliation were observed along the eastern fringe of Wood Buffalo National Park along the Slave River and on the islands of Slave River (Figure 2).

Northern East Slopes and Parkland, Bow, Prairie Regions

There was no visible budworm defoliation in these two regions in 2000.

Forecast for 2001 Based on Pheromone Trap Catches in 2000

The spruce budworm moth populations in several forest stands located across the Green Area were monitored to forecast risk of spruce budworm outbreaks occurring in 2001. These stands were considered to be at high risk of being defoliated by the spruce budworm in the near future. Multi-Pher I® traps (Le Groupe Biocontrole, Quebec) baited with female sex pheromone lures (Biolure®, Consep Membranes Inc., USA) were used to monitor the spruce budworm male moth populations. The monitoring procedure is described in the "Spruce Budworm Management Guide" (Ranasinghe and Kominek, 1998).

One hundred and seventy-three monitoring plots were established across the province. The results from five of these plots were questionable and were excluded from further consideration. The forecast based on the results from the other 168 plots is shown in Figure 3. According to these survey results, no spruce budworm outbreaks are expected either in the PBP Region or in the NES Region in 2001. The tendency for occurrence of new budworm outbreaks has declined in the NEB Region and in most parts of the NWB Region. However, the risk of new outbreaks occurring in 2001 continues to be high in the Upper Hay Forest Area of the NWB Region.

Parkland, Bow, Prairie Region

In the PBP Region, 12 plots were set up as follows in the four forest areas of: Bow (4); Brazeau (1); Clearwater (5); and, Crowsnest (2). The average moth catches showed a moderate risk of a spruce budworm outbreak in two of the plots located in Peter Lougheed Provincial Park in the Bow Forest Area. The trap catches in all the other plots showed a low risk of a budworm outbreak in 2001. Overall, the risk of a budworm outbreak is low in 2001 in this region. The sites with the moderate risk of an outbreak have to be monitored closely in 2001.

Northern East Slopes Region

In the NES Region, 19 plots were set up as follows in the forest areas of: Foothills (11); Woodlands (3); and Yellowhead (5). In the Foothills Forest Area, as predicted in 1999, trap catches increased in 2000. This area has the two-year cycle budworm, *Choristoneura biennis*

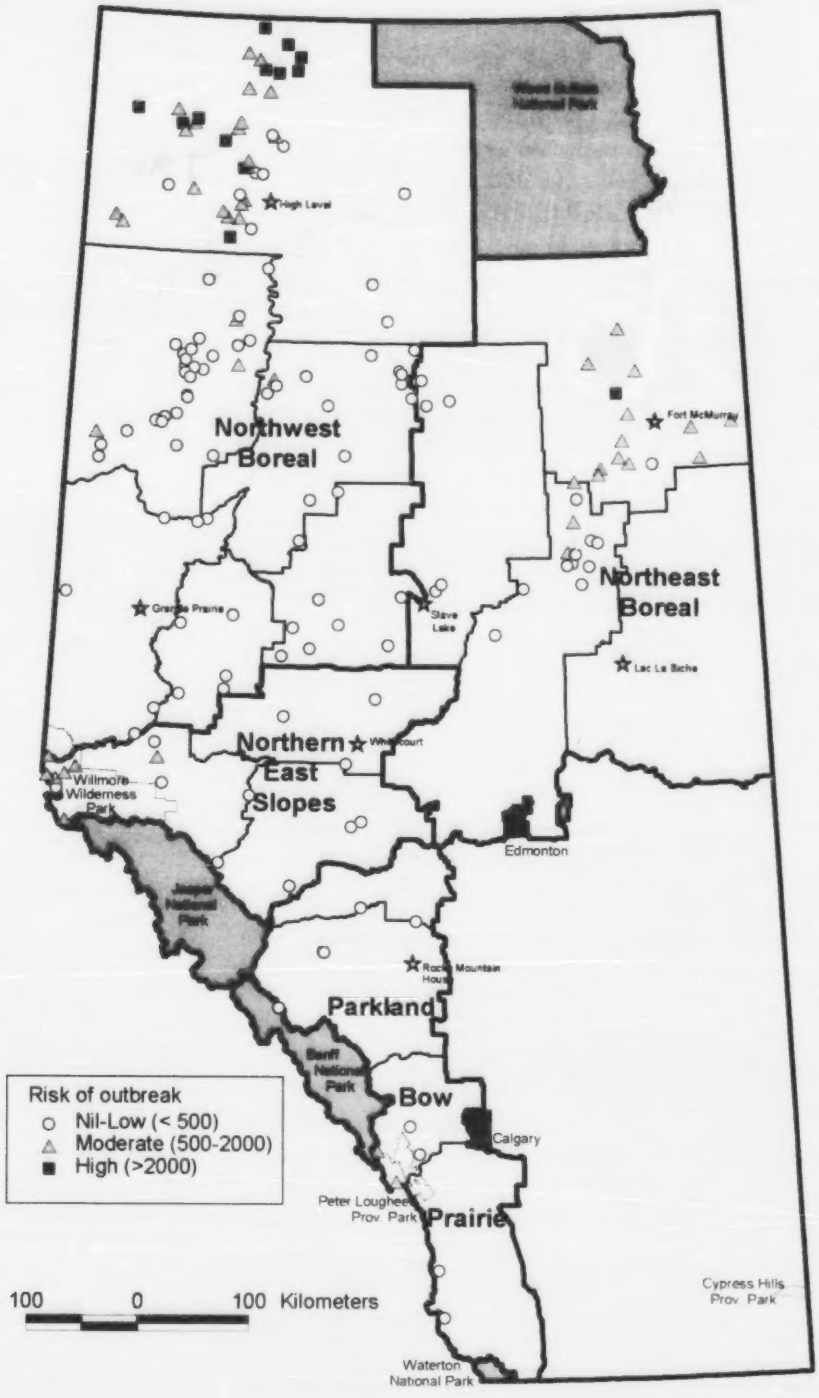

Figure 3. Predictions on risk of spruce budworm outbreaks occurring in Alberta in 2001, based on moth catches in pheromone-baited traps in 2000.

Free., because the trap catches have been alternating between high and low numbers in consecutive years. The average trap catches indicated a low risk of an outbreak in three plots (149–397 moths per trap); a moderate risk of a spruce budworm outbreak in seven plots (865–1995 moths per trap); and a high risk of a budworm outbreak in one plot (2098 moths per trap). No visible defoliation is expected in this plot in 2001 because moth populations are expected to be low. However, visible defoliation by the two-year cycle budworm is likely to occur in Willmore Wilderness Park in 2002. In the Woodlands Forest Area, the average catches in the three plots ranged from 4 to 78 spruce budworm moths per trap. The risk of a spruce budworm outbreak occurring in 2001 is low in this forest area. The five trap sites in the Yellowhead Forest Area had catches varying from 17 to 229 moths per trap. The risk of a spruce budworm outbreak occurring in this forest area in 2001 is low.

Northeast Boreal Region

In the NEB Region, 36 plots were established as follows in the forest areas of: Athabasca (15); Marten Hills (6); and, Waterways (15). The results of this survey are shown in Figure 3.

In the Marten Hills Forest Area, the average trap catches in five plots ranged from 19 to 439 moths per trap. The risk of a budworm outbreak occurring in these plots in 2001 is low. The results from the other plot were excluded because of trap disturbance.

In the Athabasca Forest Area, pheromone trap catches indicated a low risk of spruce budworm outbreaks in 10 plots (13–496 moths per trap) and a moderate risk of an outbreak in two plots (1205–1463 moths per trap) in 2001; the other three plots had questionable results due to trap disturbances. Overall, there is a low risk of new budworm outbreaks occurring in this forest area in 2001.

In the Waterways Forest Area, risk of an outbreak occurring in 2001was high in one plot (3213 moths per trap); moderate in 13 plots (range: 544–1911 moths per trap); and low in one plot (319 moths per trap). The plot with a high risk of an outbreak was located northwest of Fort McMurray, along the MacKay River. This area needs closer monitoring in 2001 because the other plots located in surrounding areas had moderate risk of budworm outbreaks in 2001. Two plots along the Clearwater River and one plot along the Christina River (far away from current defoliation) had moderate risk of spruce budworm outbreaks in 2001. The forest stands around these three plots have to be monitored closely for new spruce budworm outbreaks in 2001 because previous spruce budworm outbreaks have been reported in these areas.

Northwest Boreal Region

In the NWB Region, traps were established as follows in the forest areas of: East Peace (15); Lakeshore (8); MacKenzie (30); Smoky River (5); Upper Hay (44); and, Wapiti River (5). The results of this survey are shown in Figure 3.

The risk of a budworm outbreak occurring in 2001 is low in the forest areas of Lakeshore (14–43 moths per trap); Smoky River (2–263 moths per trap); and, Wapiti River (30–136 moths per trap). Historically, risk of spruce budworm outbreaks occurring in these forest areas have been low.

In the East Peace Forest Area, the risk of a budworm outbreak occurring in 2001 is low (22–378 moths per trap) in 14 out of 15 plots (93%). The other plot has a moderate risk of an outbreak (515 moths per trap) in 2001. Overall, there is a low risk of a new outbreak occurring in 2001 in this forest area.

In the MacKenzie Forest Area, the risk of a spruce budworm outbreak occurring in 2001 is low in 27 out of 30 plots. The other three plots have a moderate risk of an outbreak (595–1010 moths per trap) occurring in 2001. Overall, the risk of new budworm outbreaks occurring in 2001 is low in the MacKenzie Forest Area.

In the Upper Hay Forest Area, 12 plots had trap catches with a high risk of an outbreak in 2001 (2101–3208 moths per trap). Half of these plots were located in the Cameron Hills/Steen River area. New outbreaks are most likely to occur in these areas in 2001. The other plots with high risk of budworm outbreaks occurring in 2001 were located east of Zama City; near Adair Fire Lookout Tower; along the Hay River near Meander River; northwest of Hutch Lake; and, north of Paddle Prairie Metis Settlement. In this forest area, 20 plots have a moderate risk of an outbreak (529–1961 moths per trap) occurring in 2001. These plots were located mainly along the Hay River near Meander River, along the Jackpot Creek, southwest of High Level and south of Rainbow Lake. Eleven other plots in this forest area have a low risk of budworm outbreaks (148–374 moths per trap) in 2001. One pheromone plot in this forest area had questionable results due to trap disturbance. These results indicate that overall, there is a high risk of new spruce budworm outbreaks occurring in this forest area in 2001.

Forecast for 2001 Based on Second-Instar Larval Survey Results in 2000

Second-instar (L_2) larval surveys were carried out in forest stands that have been defoliated by the budworm during the current outbreak and in their vicinities. The results of these surveys were used to forecast the severity of defoliation expected in 2001 in the currently infested areas (Figure 4). The survey procedures are described in the "Spruce Budworm Management Guide" (Ranasinghe and Kominek, 1998).

Northwest Boreal Region

In the NWB Region, 189 L_2 plots were established. All the plots were located in unsprayed stands because there was no aerial spraying in 2000 to control the spruce budworm in Alberta.

In the MacKenzie Forest Area, 7 out of 11 plots had larval counts that forecast severe defoliation in 2001. All of these plots were located in the Paddle Prairie Metis Settlement. This was expected because the Metis Settlement did not spray the affected area during the last two years, in spite of a severe spruce budworm outbreak. In 2001, severity of budworm defoliation is expected to remain high in the northwestern end of the Paddle Prairie Metis Settlement. If severe defoliation continues in the Metis Settlement, there may be tree kill there within the next few years and, consequently, the infestation may collapse due to lack of food supply for the budworms. Another plot in this forest area had no budworm counts and the other three plots had low budworm counts. The plot with no budworm counts and one of the plots with low budworm

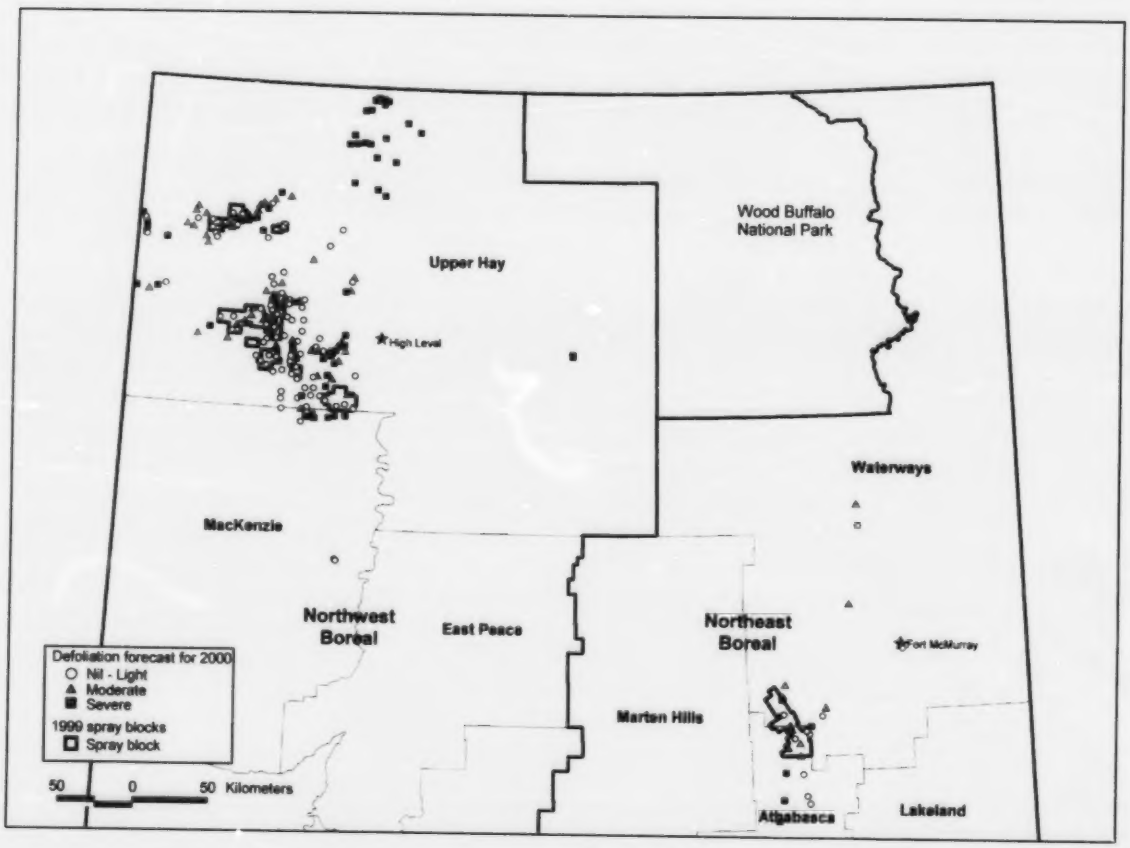

Figure 4. Forecast on spruce budworm defoliation severity in Alberta in 2001, based on the second-instar larval counts in 2000.

counts were located in Hawk Hills Area where a perennial budworm infestation collapsed in 2000. Nil to light budworm defoliation is expected in Hawk Hills plots in 2001.
In the Upper Hay Forest Area, 178 plots were established. The larval counts predicted severe defoliation in 52 plots (29%); moderate defoliation in 48 plots (27%); light defoliation in 69 plots (39%); and, no defoliation in nine plots (5%) in 2001. Thus, either moderate or severe defoliation is expected in 56% of these plots in 2001. In comparison, only 48% of the unsprayed plots were expected to have moderate or severe defoliation in 2000. This shows that the tendency is for the severity of defoliation to increase in this forest area in 2001. This is reflected in a corresponding increase of the average number of budworms per 10 m^2 of foliage from 444.35 in 1999 to 522.52 in 2000 in the same set of unsprayed plots. In this forest area, severe spruce budworm defoliation is expected in 2001 in the following areas: Cameron Hills west of Indian Cabins; along the Hay River; Little Rapids Creek; James Creek; Yates River; Dizzy Creek; Steen River and Jackpot Creek; north of Zama City; along the South Shekelie River; east of the Chinchaga River (Townships 108 and 109 within Range 01, west of the Sixth Meridian); north of the Paddle Prairie Metis Settlement; southwest of High Level; and southeast of John D'or Prairie. In this forest area, moderate defoliation is expected in 2001 near Amber Tower; west of Zama City; along the Negus Creek; northwest of Hutch Lake and possibly along the West Sousa Creek. In this forest area, light defoliation is expected in 2001 in most of the areas sprayed in 1999. However, there is an increasing trend in the larval numbers in the previously sprayed plots as well. For example, the average larval counts per 10 m^2 of foliage increased from 132.36 in 1999 to 151.70 in 2000 in the same set of plots sprayed with *Bacillus thuringiensis* var. *kurstaki* (B.t.k.) in 1999. Overall, the severity of spruce budworm defoliation will remain high in 2001 in the currently infested stands in this forest area.

Northeast Boreal Region

In the NEB Region, 24 L_2 plots were established. All of these plots were located in stands not sprayed in 2000. The results of this survey are shown in Figure 4.

In the Athabasca Forest Area, 3 out of 12 L_2 plots located along the Athabasca River had counts indicative of severe defoliation in 2001. In comparison, none of the plots in this area had a forecast for severe defoliation in 2000. In two of these plots, the defoliation severity level forecast had changed from moderate in 2000 to severe in 2001. Among the other plots, 2001 defoliation is expected to be moderate in four plots, light in four plots and nil in one plot. Two plots located in the area sprayed in 1999 have a forecast for moderate defoliation in 2001. These two plots had a forecast for light defoliation in 2000. This indicates that the budworm populations in the areas sprayed in 1999 appear to have somewhat recovered. Overall, severity of spruce budworm defoliation is expected to rise in this forest area in 2001.

In the Waterways Forest Area, spruce budworm defoliation is expected to be severe in two plots, moderate in five plots, and light in five plots, in 2001. There is an increasing trend in defoliation severity in the plots located in the area sprayed in 1999. In three previously sprayed plots, the defoliation level in 2000 was expected to be light. In three comparable plots, defoliation level in 2001 is expected to be severe in one plot, moderate in one plot and light in one plot.

MOUNTAIN PINE BEETLE, *DENDROCTONUS PONDEROSAE* HOPKINS

Aerial Survey

Mountain pine beetle (MPB) surveys were carried out in the spring and in the fall over the Green Area in southwestern Alberta. A rotary-wing aircraft (Bell 206 Long Ranger®) was used for these surveys conducted by the Regional Forest Health Officers in the NES and PBP regions. The surveys mainly covered river valleys in the foothills of the Green Area bordering B.C. to the west and the U.S. border to the south. Willmore Wilderness Park, and parts of Waterton, Banff and Jasper national parks were also covered during this survey.

In the PBP Region, no trees symptomatic of MPB infestations were detected during the aerial surveys carried out within the Green Area. There was no sign of beetle activity in Waterton National Park.

In Banff National Park, the MPB activity increased considerably in 2000 (Figure 5). Leo Unger (Canadian Forest Service, Pacific Forestry Centre) carried out a ground survey in September in the infested areas in Banff National Park. His preliminary findings showed two new attacks—one at Mount Norquay and another at Stoney Squaw Mountain—besides the existing MPB infestations along the Healy and Brewster creek drainages. Altogether, an estimated 700 green- attack trees were found at these four sites in 2000. The MPB populations at Mount Norquay and Stoney Squaw Mountain are expected to build up quickly in 2001. The Stoney Squaw Mountain site had 2 to 3 "faders" in 1999; these increased to 15 to 20 "faders" in 2000. About 150 green-attack trees were counted at this site during the ground survey. At Mount Norquay there were three "faders" and 19 green-attack trees in 2000. There were about 10 MPB infestations along the Healy Creek. These showed various rates of population increases due to differences in slope, aspect, steepness and other site-related factors. One of these sites has expanded from about 25 "faders" to about 150 green-attack trees. There were an estimated 500 green-attack trees along the creek, with the largest concentration on steep southerly aspect slopes below Sunshine Road. The infested site at Brewster Creek expanded quickly in response to the warmer weather in 1998, but appeared to have slowed down since then. At this site there were about 25 green-attack trees but the MPB appeared to be in a two-year cycle. This site has the least potential for expansion (Ian Pengelley, Banff National Park, personal communications). Alberta Environment is planning to work closely with Banff National Park on a joint landscape management plan to avert MPB infestations spilling over to the Green Area of the province.

Annual aerial and ground surveys to detect pest infestations are carried out in Jasper National Park. In Jasper National Park, MPB was located for the first time in 1999 during an aerial overview survey when several attack sites were detected along the Smoky River near Bess Pass (Unger, 1999). Several recent "faders" were also mapped along Twintree Lake. During a ground probe in the Upper Smoky River area, nine spots with MPB-killed trees were located. These spots had 14 trees believed to be attacked by the MPB in 1998; eleven of the fourteen MPB-attacked trees were dead at these sites. At 4 of the 9 attack sites, five trees had current beetle attack. In general, the number of beetles emerging from the trees attacked in 1998 was low; however, few trees had good broods suggesting that all the trees attacked in 1999 may not have been detected during the ground probes. In 1999, beetle flight occurred late in the season and the resulting gallery lengths were less than three cm. Consequently, the vigour and survival of the beetles emerging in 2000 was expected to be low. In 2000, there was little or no survival

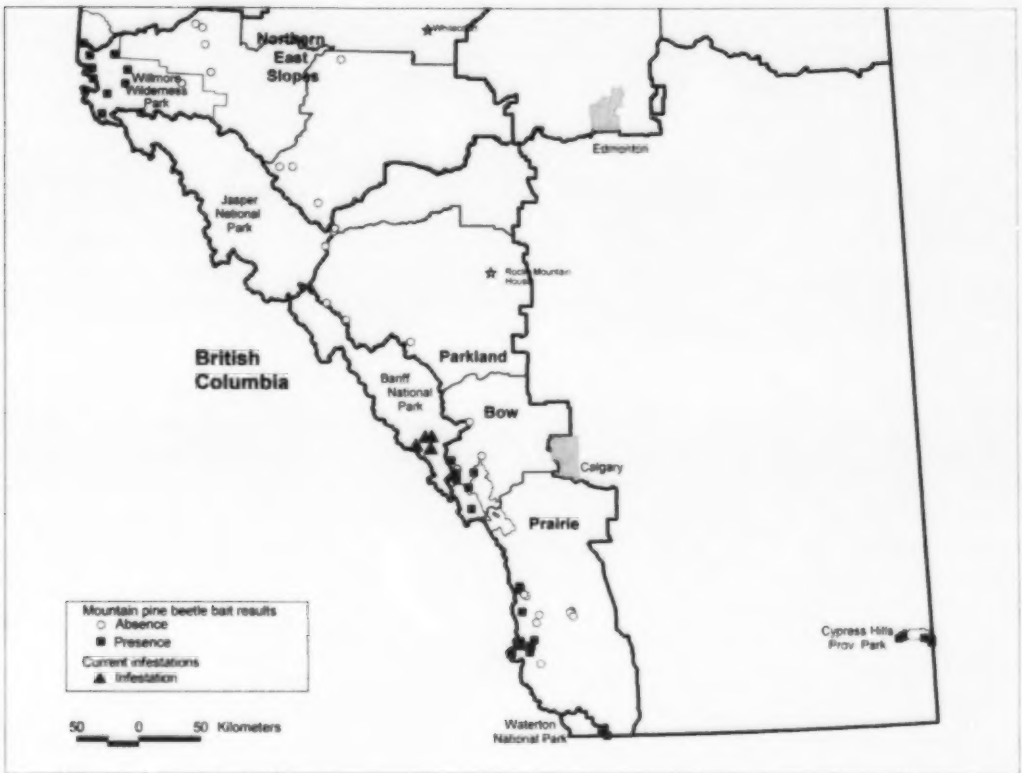

Figure 5. Mountain pine beetle infestations and occurrence of beetle-hits in plots with pheromone-baited trees in Alberta in 2000.

of MPB at 1999 attack sites. There was one new site at Chown Creek where about 15 beetle-attacked trees were visible from the air. The brood production in these infestations was moderate and the attacks were confined to damaged trees. In Jasper National Park, MPB is not considered to be a problem. The MPB attacks normally occurred simultaneously with lodgepole pine beetle, *D. murryanae* Hopkins, or turpentine beetle, *D. valens* LeConte, attacks. Most of the MPB are supposed to be on a two-year cycle and their populations are not likely to build up in 2001 (Westhaver, 2000).

In the NES Region, no new MPB infestations were observed during the aerial surveys. However, a ground probe was conducted in 2000 in the Jackpine Valley in Willmore Wilderness Park, on an infestation that was detected during an aerial survey conducted in 1999. Twenty-five beetle-killed trees were observed during this ground probe. Only two of the infested trees had live beetles.

Survey with Pheromones

In southwestern Alberta, lodegpole pine stands with a high risk of becoming infested with MPB were monitored for beetle activity. A two-component aggregation pheromone bait was used. The procedure for deploying these pheromone baits is described in "Mountain Pine Beetle Management Guide 1999" (Kominek, 1999). Sixty-one plots were established to monitor MPB activity in southern Alberta in 2000. The results of this survey are summarized in Figure 5.

In the PBP Region, 36 MPB monitoring plots were established as follows in the forest areas of Bow (10); Brazeau (2); Clearwater (4); and Crowsnest (20). There were no beetle hits in the plots located in the Brazeau and Clearwater forest areas. The percent of plots with beetle attacks varied from 55% in the Crowsnest Forest Area to 70% in the Bow Forest Area. This is a higher rate of beetle hits compared to the results in 1999. The number of beetle-hits per tree ranged from 1 to 14 in the Bow Forest Area and from 1 to 17 in the Crowsnest Forest Area. These ranges of beetle-hits are comparable to those of 1999. The beetles in these trees were removed mechanically. Overall, the incidence of MPB increased in 2000 in the Bow and Crowsnest forest areas.

In the NES Region, there were beetle-hits in 11 out of 16 plots (69%) in Willmore Wilderness Park in the Foothills Forest Area. Fourteen beetle-attacked trees at these sites are scheduled to be cut and burned in the spring of 2001. The bark on another five beetle-attacked trees was peeled off. The number of beetle hits per tree (range: 1–!18) declined in 2000 compared to that in 1999. There were no beetle-hits in four plots located in the Yellowhead Forest Area. In this forest region, the incidence of MPB remained about the same as that in 1999.

In Cypress Hills Provincial Park, all five pheromone-baited plots had beetle hits. The number of beetle hits ranged from 1 to 6 in the baited trees. One unbaited-tree had three beetle hits. This incidence of MPB is a concern because these results suggest the possible existence of a low endemic beetle population within the park. There is little likelihood of beetles immigrating to the park because there are no known beetle infestations in surrounding areas.

PINE FALSE WEBWORM, *ACANTHOLYDA ERYTHROCEPHALA* (LINNAEUS)

The decline of pine false webworm populations continued in 2000 in Edmonton. The populations were so low that these insects were practically undetectable in 2000. This reduction is likely due to the return of normal cold winter conditions in 2000 after the mild winters that were experienced in 1997 and 1998.

YELLOWHEADED SPRUCE SAWFLY, *PIKONEMA ALSKENSIS* (ROHWER)

This pest species attacked many ornamental spruces in Edmonton, prompting the city to spray permethrin to keep the populations under control. However, this pest did not attack natural spruce stands suggesting that planting exotic host species may have contributed to this problem.

DECIDUOUS PESTS

LARGE ASPEN TORTRIX, *CHORISTONEURA CONFLICTANA* (WALKER)

In 2000, the large aspen tortrix defoliated area in central and northwestern Alberta increased dramatically (Figure 6).

In the NWB Region, the large aspen tortrix defoliated area nearly tripled in 2000, compared to the area defoliated by this pest in 1999. The "gross" defoliated area, i.e., total area rather than the area of individual stands affected, was estimated to be 2 186 406 ha. Defoliation was severe over 1 814 459 ha, moderate over 337 058 ha and light over 34 889 ha. Large aspen tortrix defoliation was observed in parts of Canadian Forest Products Ltd. (Hines Creek) Forest Management Agreement (FMA) area; Daishowa Marubini International (DMI) FMA area; and Weyerhaeuser (Grande Prairie) FMA area. Specifically, defoliation was observed at Sturgeon Lake; near Snuff Mountain Fire Lookout Tower; south of Grande Prairie; Saddle Hills; Birch Hills; Clear Hills; Whitemud Hills; along the Peace River west of Fairview; in Rainbow Lake; Zama City; High Level; Fort Vermillion; around Talbot Fire Lookout Tower; east of Apache Hamburg and near Hotchkiss Fire Lookout Tower.

In the NES Region, large aspen tortrix-defoliated area also increased dramatically to reach 108 659 ha in 2000 compared to 4700 ha defoliated in 1999. This year's defoliation was severe over 89 902 ha and moderate over 18 757 ha.

No large aspen tortrix defoliation was reported from the PBP and NEB regions in 2000.

FOREST TENT CATERPILLAR, *MALACOSOMA DISSTRIA* HÜBNER

The forest tent caterpillar defoliation in northwestern Alberta decreased in 2000, compared to 1999. In contrast, there was an increase in forest tent caterpillar defoliation in southern Alberta (Figure 7).

In the NWB Region, the "gross" area with forest tent caterpillar defoliation was estimated to be 349 227 ha in 2000 compared to 584 260 ha defoliated in 1999. Within this area, defoliation was severe over 303 601 ha, moderate over 42 647 ha and light over 2979 ha. In this region, tent caterpillar defoliation was observed around Peace River, Grimshaw, Dixonville, Nampa, and Cadotte Lake areas; defoliation was also observed in the Forest Management Agreement (FMA) areas of Daishowa Marubuni International (DMI) and Tolko–High Level Lumber Division. In the NES Region, forest tent caterpillar defoliated about 400 ha in 2000 on the west side of Whitecourt Mountain. There was no forest tent caterpillar defoliation in this region in 1999. In the PBP Region, forest tent caterpillar defoliated forest stands in the Clearwater and Brazeau forest areas. This defoliation was severe over 14 113 ha, moderate over 2031 ha and light over 349 ha. The defoliated stands were found near Highway 22 and Medicine Lake. There was no forest tent caterpillar defoliation in the PBP region in 1999. In the NEB Region, there was no systematic survey of forest tent caterpillar defoliation in 2000. However, there were some signs of forest tent caterpillar infestations in Strathcona County and in the southeast and northeast parts of the City of Edmonton.

Figure 6. Areas defoliated by the large aspen tortrix in Alberta in 2000.

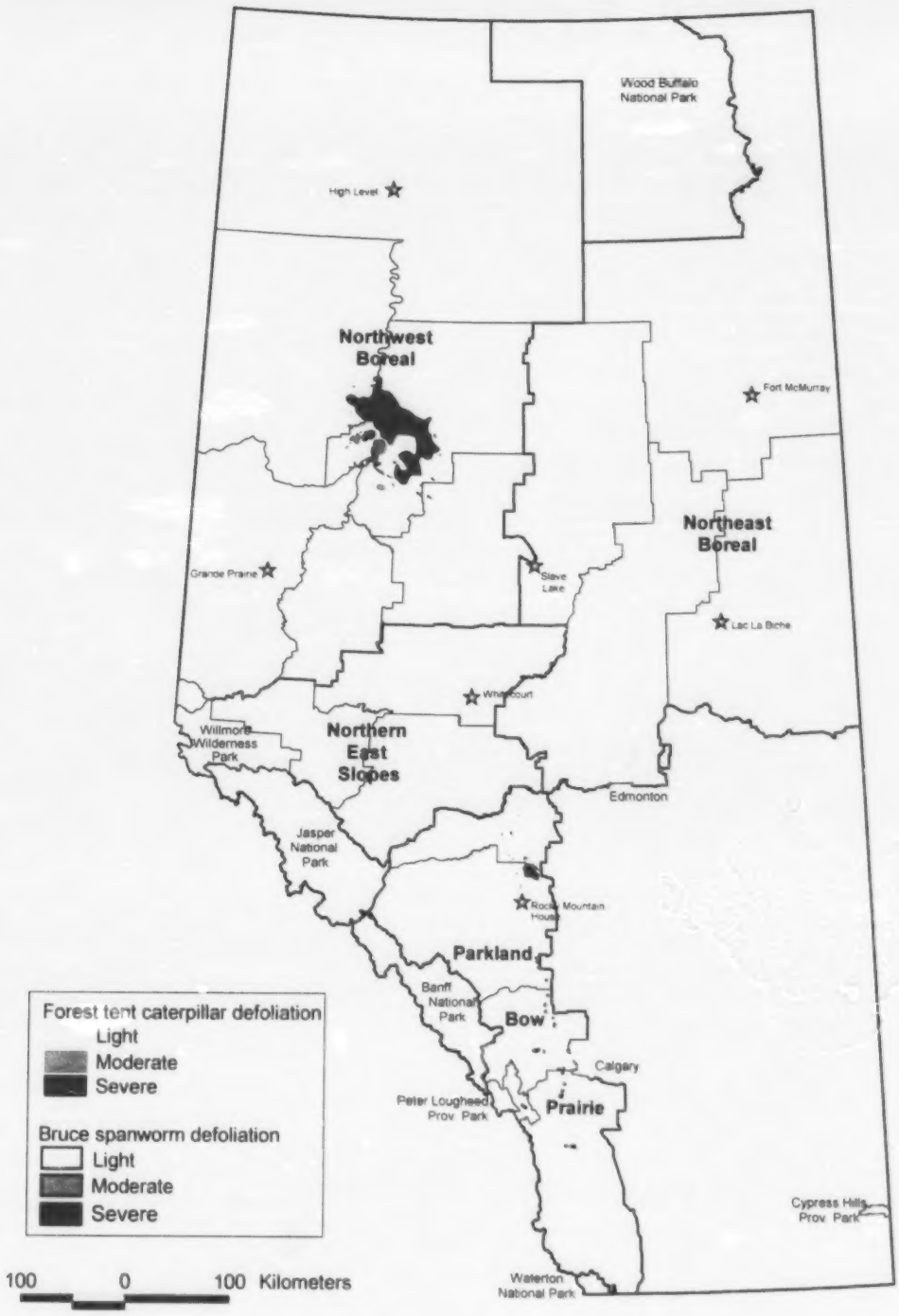

Figure 7. Areas defoliated by a) forest tent caterpillar and b) Bruce spanworm in Alberta in 2000.

BRUCE SPANWORM, *OPEROPHTERA BRUCEATA* (HULST.)

During 2000, the Bruce spanworm-defoliated area in western Alberta (Figure 7) declined significantly, compared to the area defoliated by this pest in 1999. In the NWB Region, Bruce spanworm defoliation was observed over 4640 ha about 15 km north of Peace River. Most of this defoliation was moderate (4306 ha) and the remainder was severe (334 ha). In comparison, the Bruce spanworm, in conjunction with the large aspen tortrix, was widespread over an estimated 775 497 ha in this region in 1999. In the NES Region, the Bruce spanworm populations collapsed in 2000. This occurred in spite of a relatively large number of eggs trapped (3996 eggs per 340-cm^2 band) in 1999 at one trap location. In this region, very low numbers of larvae were found in the Deer Hill area located north of Edson. In 2000, the number of eggs in the oviposition traps (Hébert and St-Antoine, 1999) declined as well. The average egg counts per cm^2 were 0.18, 0.012, and 0.0006 at Deer Hill, Tom Hill #1 and Tom Hill #2, respectively. There was an average of 0.016 eggs per cm^2 at a new trapping site located in the Obed area west of Hinton.

In the PBP Region, the Bruce spanworm populations collapsed in 2000 with the defoliation limited to 1685 ha in the Porcupine Hills. Defoliation was severe over 1421 ha and light over 264 ha. In comparison, Bruce spanworm defoliation was severe over an estimated 42 236 ha in 1999. There was an average of 0.04 eggs per cm^2 in the oviposition traps in 2000.

SATIN MOTH, *LEUCOMA SALICIS* (LINNAEUS)

In Edmonton, 88 new satin moth infestations were detected in 2000. This is a slight decrease compared to 110 new infestations detected in the city in 1999. This decline in satin moth infestations is ascribed, at least in part, to the return of normal cold winters, an important cause of overwintering larval mortality. This pest, first detected in 1994 in Northwest Edmonton, is now believed to be firmly established in Edmonton and surrounding communities of Sherwood Park, St. Albert and the Canadian Forces Base at Lancaster Park.

In 2000, the City of Edmonton sprayed 4700 trees with Ambush® 500 E.C. (permethrin) for satin moth control. The City of Edmonton also continued field and laboratory trials on the use of Mimic® 240LV (tebufinozide) for satin moth control.

A braconid parasitoid (*Cotesia melanoscela*) caused 40% larval mortality over two generations of satin moth in Edmonton. However, this parasitoid does not attack late larval instars of satin moth and suffers from a high degree of hyperparasitism. In view of this, the city is seeking to enhance biological control of satin moth by introducing another parasitoid, *Meteorus versicolor;* this parasitoid attacks all the larval stages of the satin moth. This parasitoid is prevalent in British Columbia. In 2000, Alberta-Pacific Forest Products Ltd (Al-Pac) provided funding for a joint project between Alberta Environment and the City of Edmonton to initiate research towards introducing this parasitoid into Alberta.

BLACK ARMY CUTWORM, *ACTEBIA FENNICA* TAUSCHER

The black army cutworm outbreak, recorded for the first time in Alberta in the summer of 1999, collapsed in 2000. This outbreak occurred in the NES Region following a large-scale fire that burned approximately 170 000 ha in Virginia Hills in May 1998. The black army cutworm consumed annual herbaceous vegetation as well as conifer seedlings in many recently planted, fire-killed cutblocks. A survey carried out in 2000 showed that conifer seedlings defoliated by the black army cutworm in 1999 have recovered with no mortality.

GYPSY MOTH, *LYMANTRIA DISPAR* (LINNAEUS.)

The Land and Forest Service of Alberta Environment set up 50 Disparlure®-baited Delta traps as part of the annual gypsy moth survey conducted by the Canadian Food Inspection Agency (CFIA). Altogether, 494 gypsy moth traps were set up across the province by various co-operating agencies. Twelve of these traps were lost. Two of the 482 active traps had a gypsy moth each; one was trapped near Redwater and the other northwest of Calgary (Hiro Koga, CFIA, Calgary, personal communication).

BIRCH LEAFMINERS, *PROFENUSA THOMSONI* (KONOW) AND *FENUSA PUSILLA* (LEPELETIER)

The researchers at the University of Alberta and the Canadian Forest Service (Northern Forestry Centre) introduced an ichneumonid wasp (*Lathrolestes nigricollis)*, a parasitoid of *F. pusilla,* to control this pest in Edmonton. This parasitoid spread rapidly within the city providing effective biological control of this leafminer sp. In 2000, the percent of parasitized leafminer larvae ranged from 86% to 100% among the neighbourhoods of the city. Another introduced ichneumonid wasp (*L. luteolator)* is credited with controlling the amber-marked birch leafminer outbreak in the city. Field surveys carried out in July–August 2000 showed that *L. luteolator* has spread across the province.

FALL CANKERWORM, *ALSOPHILA POMETARIA* HARRIS

Fall cankerworm outbreaks periodically occur in Edmonton although these outbreaks are not as severe as those that occur in central Canada. The planting of elm, ash and linden trees by the city has facilitated the establishment of this pest in Edmonton. In 2000, fall cankerworm populations were at endemic levels as expected by the high level of egg parasitism observed in the past few years. Consequently, the city neither monitored the populations nor sprayed to control them in 2000.

SMALLER EUROPEAN ELM BARK BEETLE, *SCOLYTUS MULTISTRIATUS* (MARSHAM)

In 1998, the Society to Prevent Dutch Elm Disease (STOPDED), a non-profit organization, was established to protect and preserve Alberta's elm trees from DED. The STOPDED monitors vector populations and DED incidence in the province. The smaller European elm bark beetle (SEEBB) has been found recurrently in Calgary since 1994; in Edmonton since 1995; and in Medicine Hat since 1998. This beetle has been trapped in the past in Red Deer, Vauxhall, High River, St. Albert, Coutts, near Balzac and in Strathcona County.

In 2000, the STOPDED monitored 134 municipalities, 51 provincial or municipal parks, 32 plant nurseries, and all of the ports-of-entry at Alberta–Montana border for SEEBB. Pheromone-baited sticky traps (Phero Tech Inc., B.C.) were set up at 471 sites at the above locations. Again, SEEBB was trapped this year—albeit in relatively lower numbers compared to the previous years—in Calgary, Edmonton, and in Medicine Hat. In Edmonton, SEEBB catches have steadily declined in the recent years. In 2000, only three beetles were trapped; these were found at 2 out of 100 trapping sites. This is a further reduction in the number of beetles trapped compared to seven beetles trapped in 1999. This year, the SEEBB were trapped for the first time in the municipalities of Killiam and Lloydminster. The trap catches over the years suggest the presence of endemic SEEBB populations in Alberta. However, there is still no conclusive evidence of their establishment, i.e., SEEBB galleries with live beetle larvae in elm in Alberta.

The other vector species—native elm bark beetle, *Hylurgopinus rufipes* Eichhoff—has not been trapped in Alberta.

DUTCH ELM DISEASE (DED), *OPHIOSTOMA ULMI* (BUIS.) NANNF.

The STOPDED provides education and public awareness of this disease. This society also has a program to confiscate any elm wood encountered at the ports-of-entry to Alberta from Montana and Saskatchewan.

In spite of having a relatively large American elm population, Alberta still remains free of Dutch elm disease (DED). The presence of DED in Alberta was confirmed from samples collected in 1998 from an elm tree in Wainwright; this tree was cut and burned. No new cases of the disease have been reported since in Alberta.

In 2000, several lots of elm wood were confiscated at ports-of-entry at Coutts, Carway and Chief Mountain. Wood confiscated at Carway had SEEBB galleries.

Further information on the DED program in Alberta can be found at the internet website: http://www.agric.gov.ab.ca/ded

OTHER NOTEWORTHY PESTS

In the NWB Region, there was a localized outbreak of northern tent caterpillar, *Malacosoma californicum pluviale* (Dyar), in the Upper Hay Forest Area. Many silk nests constructed by this pest were observed in mid-June in a bog east of Steen River. Approximately 80% of the willow at this location had one or more nests. Many larvae were observed on defoliated willow plants.

Ash flower gall mite, *Aceria fraxiniflora* (Felt), produced many galls on ornamental trees, especially on black ash, in Edmonton in 2000. On black ash, the galls were large and caused mechanical strain on the branches. Normally, these galls are considered to have a cosmetic effect that reduces the aesthetic values of the affected trees.

In 2000, the pine needle cast, *Lophodermella concolor* (Dearn.) Darker, affected large tracts of pine stands in Kananaskis Country in the PBP Region. This infection was widespread from Bow Valley to the Crowsnest Pass in southern Alberta. The infected area was estimated to cover 21 945 ha; infection was moderate over 8301 ha and severe over 13 644 ha. Many infected tree crowns appeared either yellow or red providing a spectacular view of colour in valleys of the infected areas.

Since 1996, over 100 American elm trees in Edmonton have been affected by a vascular wilt disease caused by the fungus, *Dothiorella ulmi*. This disease results in progressive die back and eventual tree mortality. In 2000, another 58 elms with wilt symptoms were observed in the city; eighteen of these are confirmed to have the disease and diagnoses on the remaining 40 elms are pending. Areas with high elm density appear to be more prone to this disease. Radical pruning of affected branches, as well as nearby healthy looking branches at early stages of the disease, appears to be effective in controlling it. Once the disease symptoms are well established and are closer to the main stem, pruning has no effect. The city researchers are planning to test the effectiveness of the systemic fungicide, Alamo® (propiconazole) in controlling this disease.

NOXIOUS AND RESTRICTED WEEDS

PROVINCIAL

The Forest Health Program is also responsible for managing noxious and restricted weeds in the Green Area of the province. These weeds are invasive, exotic plant species that deem to pose a threat to the natural ecosystems of the province.

In 2000, the provincial weed management program focussed on education and increased awareness, field surveys to inventory noxious and restricted weeds, and control of these weeds. Provincially, a poster entitled "Problem Weeds of Alberta's Green Area" was printed and distributed to increase noxious and restricted weed awareness among stakeholders in the Green Area. As well, the LFS was involved in co-operative initiatives of weed management with the Natural Resource Service (NRS), various Municipal Districts and Counties, and many resource industry companies.

REGIONAL

NORTHERN EAST SLOPES (NES) REGION

In the NES Region, the weed management program included:

- Education and Awareness
- Inventory
- Control

Education and Awareness

The Northern East Slopes Weed Awareness Group is composed of representatives from Municipal Districts (Big Lakes, Brazeau, Greenview, Woodlands and Yellowhead), LFS, and Alberta Agriculture, Food and Rural Development. In 2000, several sessions on weed awareness and training were held for the benefit of individual companies operating in the region. This year, posters and pamphlets on noxious and restricted weeds were distributed to 47 companies in the Woodlands Forest Area and the general public. In the Foothills Forest Area, three pamphlet holders with weed identification and information materials were erected at Rock Lake and Sulphur Gates; these are the major trail riding and outfitting staging areas in this forest area.

Inventory

Three weed technicians were hired, one for each of the three forest areas within the forest region, for the 2000 field season. The technician was responsible for weed inventory, education and awareness within the respective forest area. In the NES Region, noxious and restricted weeds at approximately 300 sites were inventoried during 2000. These sites included provincial parks and recreational areas; forest fire lookouts and cabins; oil and gas dispositions; cutblocks and cattle grazing areas.

Spotted knapweed (*Centaurea maculosa* Lam.), a restricted weed, was found at a Canadian National Railway (CN) site in the Woodlands Forest Area. The Municipal District of Greenview issued a weed notice to CN regarding this infestation.

Control

In 2000, Alberta Environment entered into co-operative agreements with other stakeholders to co-ordinate the weed management programs in the region. These stakeholders included the County of Yellowhead and other industries.

A knapweed infestation has been occurring for several years at a CN site in Hinton in the Foothills Forest Area. Consequently, the County of Yellowhead issued a weed notice to CN. Several times throughout the season these weeds were picked, bagged and burned. In the Woodlands Forest Area, weed infestations found on Crown land are being prioritized for control in 2001. Weed infestations found on industrial dispositions were reported to the disposition holders either by the weed technician or by the weed inspector of the Greenview Municipal District. In the Yellowhead Forest Area, forestry recreation areas and horse holding areas were spot-sprayed by using backpack sprayers. A mixture of Escort® and MCPA Amine® were sprayed on sites at Watson Creek, Whitehorse Creek, Lambert Creek, Coalspur, McLeod River, Lovett snowmobile staging area, and at Fairfax Lake. Herbicides, mostly Tordon®, were sprayed under the co-operative program along right-of-ways of Wolf Lake Road, Elk River Road, Highway 40 from Coalspur to Cadomin and Highway 47. In the Foothills Forest Area, 14 out of 18 sites sprayed for weed control in 1999 still retained over 75% control.

PARKLAND, BOW, PRAIRIE (PBP) REGION

In the PBP Region, the weed management program composed of:

- Inventory
- Control

Inventory

The extent of weed infestations in the PBP Region increased in 2000. This increase can be attributed to an improved inventory and covering of a wider area extending into the backcountry. Input from associated municipal districts, disposition holders and educated public has further expanded the current inventory.

In the Brazeau Forest Area 1386 km of trails were surveyed. In the Clearwater Forest Area, approximately 103 680 ha were surveyed. In the Bow Forest Area, Alberta Environment funded surveys completed by the Natural Resources Service (NRS) in Kananaskis Country and in the Green Area north of the Bow River to the Red Deer River. The Crowsnest Forest Area stands alone, as it has a reasonable inventory of all weed infestations. In this forest area, 1086 ha within the Green Area are infested with restricted and noxious weeds. Tall buttercup (*Ranunculus acris* L.), ox-eye daisy (*Chrysanthemum leucanthemum* L.), scentless chamomile (*Matricaria maritima* L.), Canada thistle (*Cirsium arvense* L.), and blueweed (*Echium vulgare* L.) are among the most common weed species in the region.

Control

The spray contractors and Alberta Environment controlled weeds on unoccupied Crown land within the Green Area of the PBP Region. In the Clearwater Forest Area, Alberta Environment, disposition holders, grazing lease holders and the municipal districts co-operated to manage noxious weeds over 235 ha in multiple-use areas. In the Bow Forest Area, LFS funded the NRS to control weeds in the priority areas identified in their surveys. Several park areas adjacent to the Green Area treated included 22 ha of Canada thistle and leafy spurge. In the Crowsnest Forest Area, control efforts concentrated on new infestations, and a "contain and control" approach was taken where infestations are established. In this area, Alberta Environment, disposition holders, and municipal districts co-operated to proactively manage weeds at the landscape level. The only restricted weed found and controlled in the PBP Region in this year was knapweed (*Centaurea sp.*), infesting 2.4 ha in the Municipality of Crowsnest. The following herbicides were used to control noxious and restricted weeds in the PBP Region: 2, 4-D, Banvel®, Dycleer®, Escort®, Sylgard®, Tordon 22K® and Tordon 101®. In sensitive areas where herbicide use is restricted or where some small infestations were found, weeds were hand-pulled. This year, there was no weed control in the Brazeau Forest Area.

NORTHWEST BOREAL (NWB) REGION

In the NWB Region, the weed management program composed of:

- Education & Awareness
- Inventory & Control

Education & Awareness

A workshop was held in the NWB Region, to familiarize the LFS staff with restricted and noxious weed management. At this workshop, a weed scientist (Debbie Bigelow) presented information on biology and control of weed species relevant to the region.

Inventory & Control

Restricted and noxious weed surveys were completed in the Mackenzie, East Peace, Smoky River and Wapiti forest areas. Scentless chamomile (*Matricaria maritima* L. var. *agrestis* [Knaf.] Wilmot), was the main species found in these surveys. In the Mackenzie Forest Area, this weed was found along sections of Chinchaga Forestry Road, and near Hines Creek and Worsley. In the East Peace Forest Area, scentless chamomile was recorded near Seal Lake, Cadotte Lake, Red Earth and Kimiwan Forest Fire Lookout. In the Smoky River Forest Area, this weed species was found along stretches of the Simonette River. Scentless chamomile was handpicked on approximately a 16 km stretch (Section 36 Township 67 Range 26 West of the Fifth Meridian) along the Simonise River (Smoky River) in the Smoky River Forest Area. In this forest area, scentless chamomile was found at some oil and gas wellsites located south of the Sturgeon Lake. In the Wapiti Forest Area, a small patch of spotted knapweed (*Centaurea maculosa* Lam.) and diffuse knapweed (*C. diffusa* Lam.)—both restricted weed species—was found along a section of railway located south of Grande Prairie (Township 63 Range 03 West of the Sixth Meridian). In this region, no areas were sprayed with herbicides in 2000 for noxious and restricted weed control.

NORTHEAST BOREAL (NEB) REGION

In the NEB Region, the weed management program composed of:

- Education & Awareness
- Inventory & Control

Education & Awareness

The main focus of the weed management program in the NEB Region in 2000 was education and awareness. Industry field personnel in the region were provided with the resources to identify noxious and restricted weeds by LFS staff who visited the work sites. Copies of a weed poster (approx. 300) and a weed identification book (approx. 150) were distributed among industry personnel following a brief presentation about the need to control weeds.

Inventory & Control

Four weed technicians (one per forest area) were hired in the NEB Region to continue inventory of weed infestations initiated in 1999. Over 100 weed sites were identified in the Athabasca Forest Area. In the Lakeland Forest Area, scentless chamomile (*Matricaria maritima* L. var. *agrestis* [Knaf.] Wilmot) was the predominant weed species followed by Canada thistle (*Cirsium arvense* [L.] Scop.), tansy (*Tanacetum vulgare* L.) and ox-eye daisy (*Chrysanthemum leucanthemum* L.). In the Slave Lake Forest Area, two small areas infested with weeds were treated by spraying a herbicide.

In 2001, weed inventory will be continued and weed control measures will be undertaken in various areas within the region.

OTHER PROGRAMS

INCREASED AWARENESS AND TRAINING

PROVINCIAL

Increased Awareness

Posters and pamphlets

This year, the Forest Health Branch produced and distributed a poster entitled "Problem Weeds of Alberta's Green Area" to increase the awareness on noxious and restricted weeds among the stakeholders. This poster carrying short descriptions and colour illustrations depicting 11 weed species of local concern is available free of charge for distribution. Please contact either Mike Undershultz of the Forest Health Branch at (780) 427-8474 or

Information Centre
Alberta Environment,
Main Floor, Great West Life Building
9920 – 108 Street
Edmonton, AB
T5K 2M4
Telephone (780) 422-2079

The Forest Health Branch, in association with the Communications Division of Alberta Environment, produced a pamphlet that addresses commonly asked questions on the mountain pine beetle. It contains 12 questions and answers on topics ranging from MPB damage, biology, and ecology to control.

Activity Book

The Forest Health Branch and the Environmental Education Branch are currently preparing an "Envirokids Investigate Alberta's Forests: Forest Health" activity book targeted at grades 3-6, but may also be used for grades 7-8. This activity book introduces children to basic forest ecosystem concepts and the economic, environmental, and social values of the forest. The health and management of the forest is presented as a complex and an integrated process. Fire, forest insects and diseases are introduced to the children as being natural yet devastating phenomena when these run out of control in a forest. The threat of exotic species to Alberta's forests is discussed. This activity book also helps children categorize tree species, and insect, animal and disease damage. A more detailed Teacher's Guide with additional related activities will accompany this book. The activity book and teacher's guide will be available in early spring of 2001.

North American Forest Insect Work Conference (NAFIWC)

Alberta Environment, Canadian Forest Service and the University of Alberta are organizing an international conference on forest insects. This conference entitled "North American Forest

Insect Work Conference" is scheduled to be held from May 14 to 18, 2001 at the Crown Plaza Hotel in Edmonton. For details about the conference please visit the website: http://nofc.cfs.nrcan.gc.ca/nafiwc

Training

This year, the Forest Health Branch helped to organize two workshops on MPB management (see below under regions for details). Staff members from the Canadian Forest Service, Pacific Forestry Centre in Victoria, B.C, conducted these workshops.

REGIONAL

Increased Awareness and Training

Northwest Boreal (NWB) *Region*

Numerous workshops were held during 2000 to increase forest health awareness among Land and Forest Service (LFS) staff and industry personnel. These included forest pest identification workshops held for staff at Tolko–High Level Lumber Division and Vanderwell Forest Industries. A joint workshop was held to increase the spruce budworm awareness among the industry and government staff in the region and to discuss spruce budworm management strategies. Another workshop was held to educate the LFS staff on recognizing and reporting weed infestations.

Northern East Slopes (NES) *Region*

Several sessions on weed awareness and training were held in the region (see under noxious and restricted weeds); posters and pamphlets on weeds were distributed among the stakeholders as well. A workshop on mountain pine beetle (MPB) management was held at the Environmental Training Centre in Hinton. Over 30 persons representing the industry, national parks and the LFS attended this workshop. The presentations made by the visiting Canadian Forestry Service (CFS) staff from the Pacific Forestry Centre were supplemented by those of LFS and national parks staff to add a local flavour to the proceedings of these workshops.

Parkland, Bow, Prairie (PBP) *Region*

A workshop on MPB management was held in Calgary to educate the LFS and forest industry staff. The LFS and University of Calgary staff made presentations to augment those made by the visiting CFS, Pacific Forestry Centre staff. Thirty-three persons representing the forest industry, University of Calgary and the LFS attended this workshop.

Regional IPM Working Groups

Northwest Boreal (NWB) *Region*

Alberta Environment and four other industry partners have committed funds to implement a pilot project to monitor important forest pests within the region. This is the next phase of development of the proposed integrated pest management program (IPM) for this region. The pilot project will be implemented in 2001. It is expected to help in refining the proposed survey methodologies and provide more realistic estimates of costs and timelines involved in a long-term project.

RESEARCH AND DEVELOPMENT

Mountain Pine Beetle Risk Rating Model

During the previous mountain pine beetle (MPB) outbreak in Alberta in the 1970s, biological factors appeared to play a more important role than climatic factors in determining the risk of MPB infestation in forest stands. In view of this, a MPB risk rating system was developed to suit conditions found in Alberta. This model, based on Shore and Safranyk (1992) model, uses Alberta Vegetation Inventory (AVI) data, a Digital Elevation Model (DEM) and climatic conditions for stand rating. It uses the data on forest stands, climatic conditions and beetle presence to project the likelihood of MPB infestations occurring either at present or in the future. This system was built as an "extension" in ArcView to predict the stand susceptibility to the MPB. This model needs to be field-tested to verify its validity. Upon validation, this model will provide a useful tool for forest managers to decide on beetle-proofing their management units.

Satin Moth Pheromone

The satin moth, already established in Edmonton, is a potential threat to aspen stands in the Green Area of the province. The lack of a pheromone bait to monitor satin moth populations has been a concern. Dr. Gerhard Gries of the Simon Fraser University in British Columbia isolated this pheromone known as leucomalure. In 2000, Alberta Environment partly funded a research project headed by Dr. Gries to formulate leucomalure for commercial production. This project resulted in further refinement of the pheromone and improved its synthesis. This pheromone synthesis procedure is expected to be commercially viable (personal communication, Dr. Gerhard Gries, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C.).

CD-ROM for Diagnosing Forest Pest Damage

The Forest Health Branch of Alberta Environment is finalizing the production of a CD-ROM entitled "Forest Pest Damage Diagnostic System." This CD is designed to help in identifying the damage caused by common forest pests including insects, animals, diseases and disorders commonly occurring in Alberta. This CD will enable the user to diagnose the probable damaging agent by selecting one or more symptoms observed on a given tree species common to Alberta. The symptoms are grouped by three host age groups and by the part of the tree affected. The database for the CD has been built and most of the images of pest damage have been digitized. Currently the database is being tested for accuracy. The CD-ROM is expected to be available for distribution in the spring of 2001.

Use of Digital Image Technology for Aerial Overview Surveys

During the summer, a multi-spectral 4-camera system developed by Phero Tech Inc., B.C. was used to find its potential role in aerial overview surveys of spruce budworm-defoliated stands in northern Alberta. This system provides vertical digital images in normal colour and in near infrared. These images are geolocated on the landscape with a GPS receiver that provides

latitude, longitude and altitude. The digital images are expected to provide the precise location, landscape features and the severity of defoliation. The basic product of the survey provides the flight lines and a map of the defoliated areas with images written in to a CD-ROM. The system is also deemed capable of delivering additional products such as thematic maps with pest intensity analysis.

Preliminary results showed that digitized vegetation inventory maps are needed to corroborate the digital images of the stands; else, it is difficult to interpret the data collected. The system also is affected by cloud cover limiting its use in routine aerial survey work. Overall, this system did not meet the expectations for its use in aerial overview surveys.

Modification of Spruce Budworm DSS to Suit Alberta Conditions

Alberta Environment, in co-operation with Tolko–High Level Lumber Division, is in the process of adapting the spruce budworm decision support system (DSS) originally developed by MacLean and Porter (1994). Under an agreement with Alberta Environment, the designers of this DSS have modified it to suit conditions found in NWB Region (MacKinnon *et al.*, 2000). This DSS will soon be field-tested in Alberta.

Field Trials

In collaboration with Dan Lux (FHO), Dr. Ken Mallett of the Canadian Forest Service in Edmonton, initiated a field trial in the PBP Region to manage Armillaria root disease by harvest stump removal. The trees were harvested in December 1999 and the stumps in the treated blocks were removed in June 2000. This study will focus on the cost vs. benefit of this treatment and its effect on incidence of Armillaria root disease in naturally regenerated stands.

In the PBP and NES regions, the Bruce spanworm oviposition traps (Hébert and St-Antoine, 1999) were used again in 2000 at the same locations as in 1999. The number of eggs per unit area of the foam trap declined, as expected by this year's decline in the spanworm populations.

In the NWB Region, Multipher® traps baited with a new formulation of forest tent caterpillar pheromone (Phero Tech Inc., B.C.) were used to monitor the forest tent caterpillar moth populations. These traps were deployed in stands that experienced light, moderate or severe defoliation in 2000. The average eggmass count in relation to the diameter at breast height (dbh) of the tree was also recorded from each test plot. This year's data are being tabulated. The defoliation severity in these plots will be recorded next year. This is a long-term field study aimed at working out a relationship between the trap catches, eggmass counts and the defoliation severity observed in the following year.

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APPENDIX I

INFORMATION ON OPERATIONAL USE OF PHEROMONES IN ALBERTA, 2000

GYPSY MOTH

Chemical component(s):	(+)cis-7, 8-epoxy-2-methyloctadecane (Dispalure®)
Lure type:	laminate strip
Trap:	Delta sticky trap
Pheromone source:	Trécé Inc., Salinas, California (purchased and distributed by Canadian Food Inspection Agency)

MOUNTAIN PINE BEETLE

Chemical component(s):	trans-verbenol, exo-brevicomin
Lure type:	pre-packed tree-bait
Trap:	not applicable
Pheromone source:	Phero Tech Inc., Delta, British Columbia

SPRUCE BUDWORM

Chemical component(s):	95% E-11-tetradecenal, 5% Z-11-tetradecenal
Lure type:	Biolure®
Trap type:	Multi-Pher I®
Pheromone source:	Consep Inc. (purchased and distributed by Dr. Chris Sanders, Natural Resources Canada, Sault Ste Marie, Ontario)

FOREST TENT CATERPILLAR

Chemical component(s):	Z5, E7 - dodecadienal
Lure type:	Flexlure®
Trap type:	Uni-trap®
Pheromone source:	Phero Tech Inc., Delta, British Columbia